

Space Debris Laser Ranging – Challenging and Rewarding

Update of the Izaña-1 station

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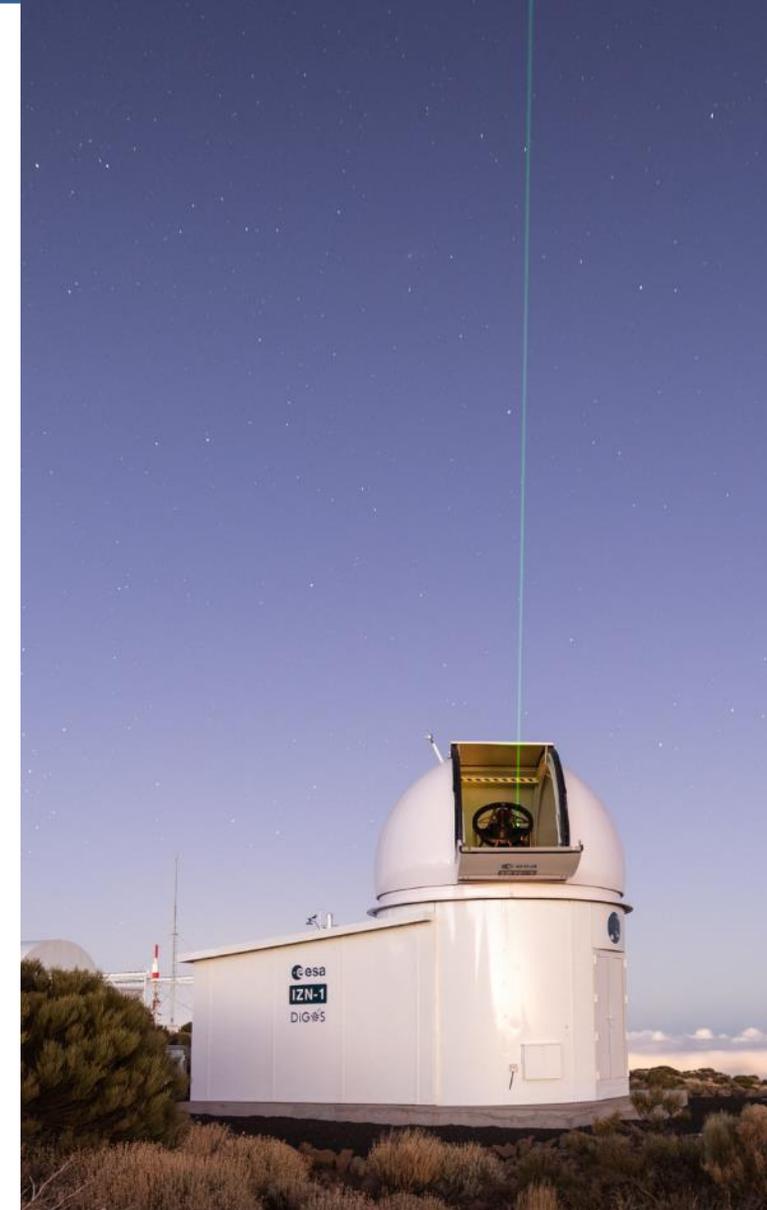
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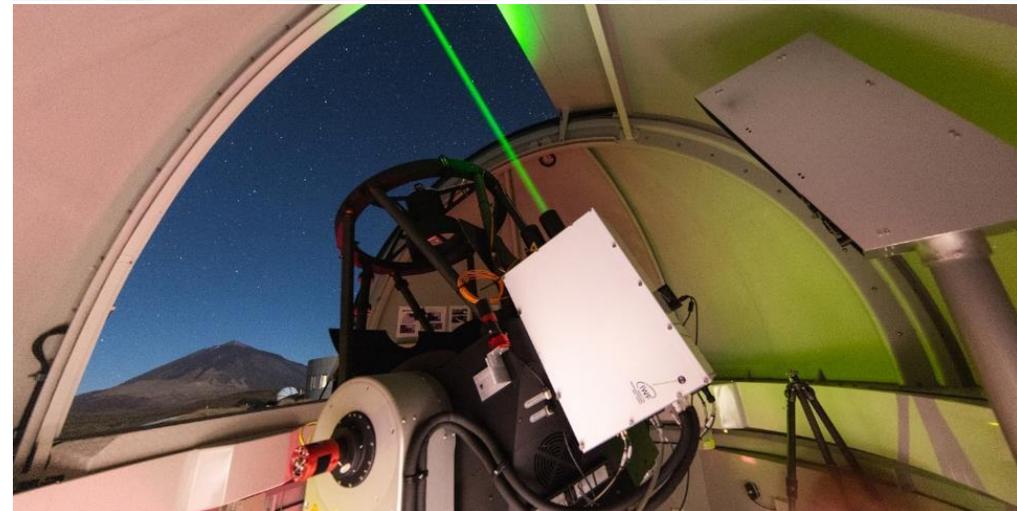
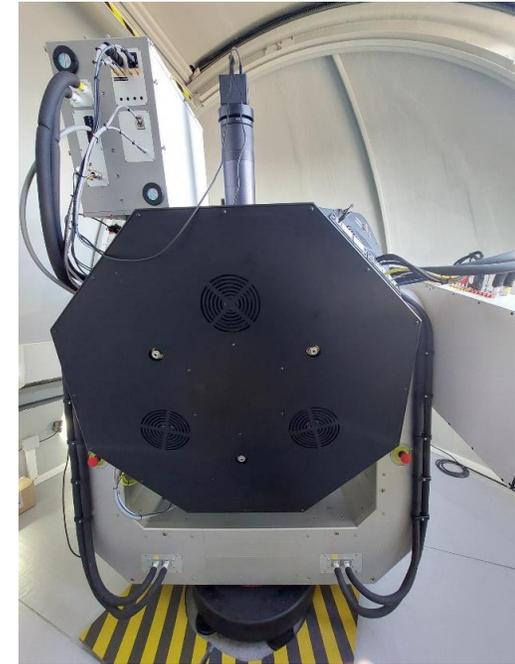
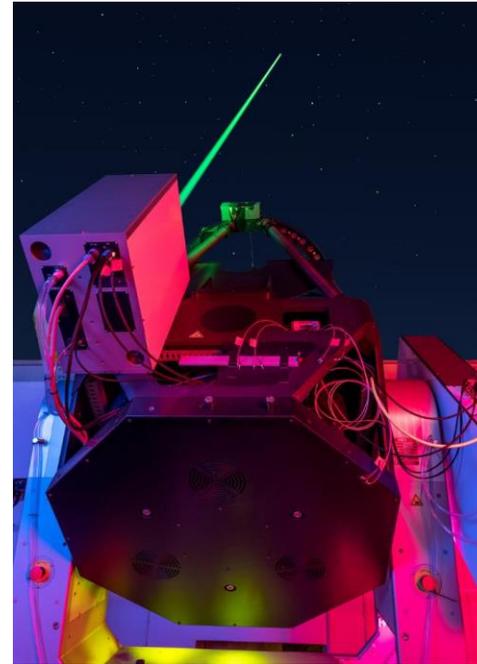
Laser Ranging – Evolution Towards Active Sensor Networking For Debris Observation and Remediation

- IZN-1 upgrade
- Debris Laser Tracking Network

Teaming: GMV (Prime), DiGOS, IWF, Libre Space Foundation



- Multi-purpose optical ground station
 - SLR
 - Laser Communication
 - Passive Optical Space Debris Observation
- 80cm alt-az Telescope
 - 2 Nasmyth foci + 2 optical ports
 1. Laser Ranging Detector package
 2. Laser communication terminal
 3. Space Debris Observation camera
 4. Not used
- Piggyback SLR Laser Package
 - Laser head, transmission optics, thermal protection & conditioning



Extended functionality

- Laser ranging to uncooperative / debris targets (day & night)
- Light curve measurements
- Stare & Chase

Full Automation for four operation modes

- SLR (cooperative targets)
- SDLR (uncooperative targets)
- Light curve recording
- Stare & Chase



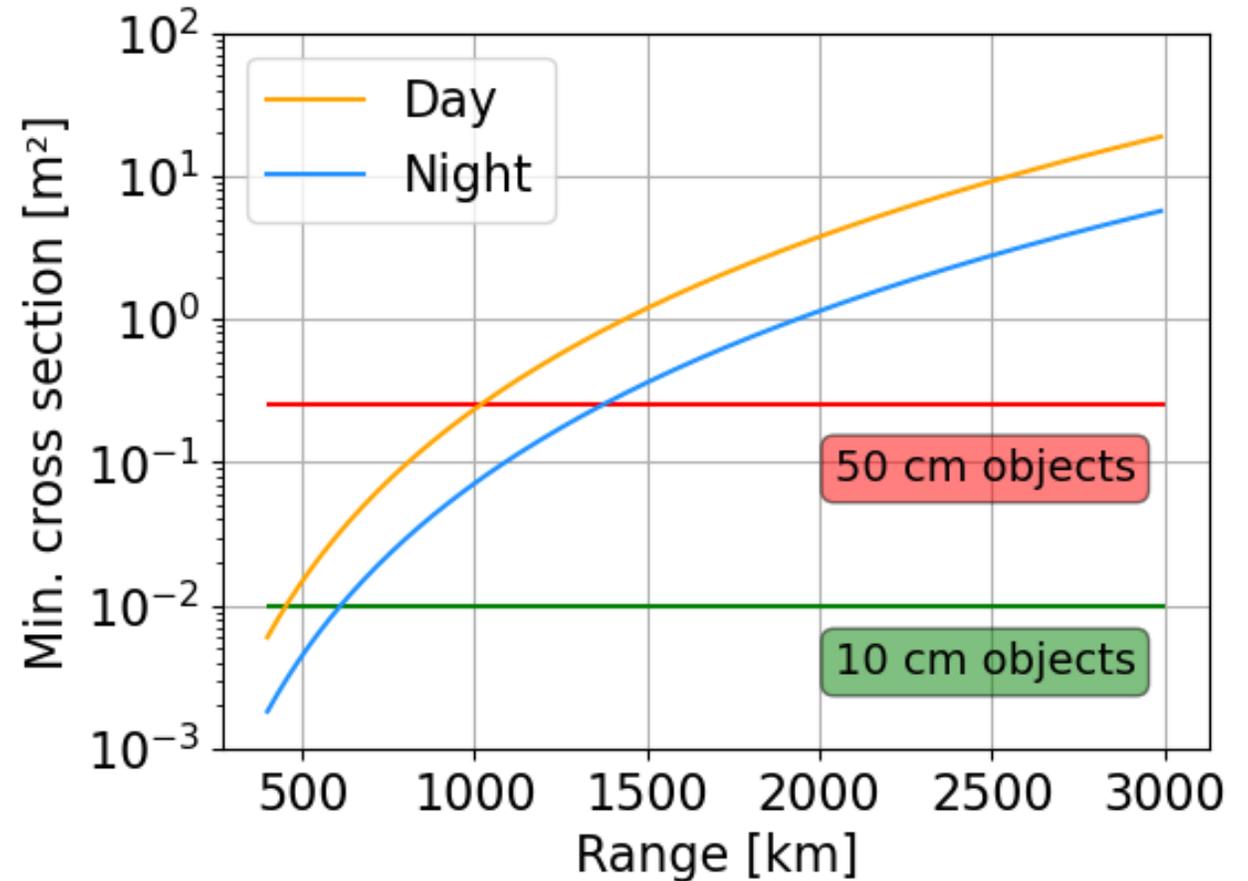
Goals

Night time

- 10 cm objects up to 600 km
- 50 cm objects up to 1400 km
- Larger objects (e.g. rocket bodies) up to 3000 km

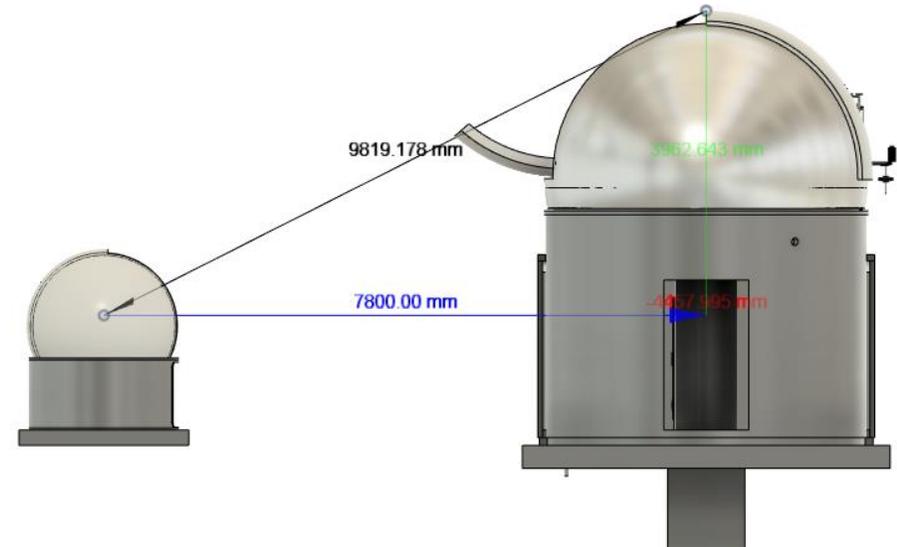
Day time

- 50 cm objects up to 1000 km



→ Split configuration

- Separate cylindrical section, dome, mount & SD laser package
- Additional guiding refractor with wide FoV (stare & chase)
- No modifications of the existing SLR system
- More flexible laser choice (i.e. dimensions)
- Design can be used on other SLR stations



SD Laser Package

- Air-conditioned housing for protection against environmental hazards
- Rigid mechanical interface to the telescope mount
- Sensors for monitoring temperature and humidity
- Stable platform for all optical components

High-power Space Debris Laser

Specs (excerpt)

Wavelength	1064nm
Repetition Rate	200Hz
Pulse Energy	>180mJ
Pulse Width	5-9ns

Dome & cylindrical Base

- Diameter: 2m

L-mount

- Alt-Azimuth Direct Drive Mount

Tx Telescope

- Aperture 200mm
- Focal length 600mm
- Focal ratio f/3

CMOS Camera

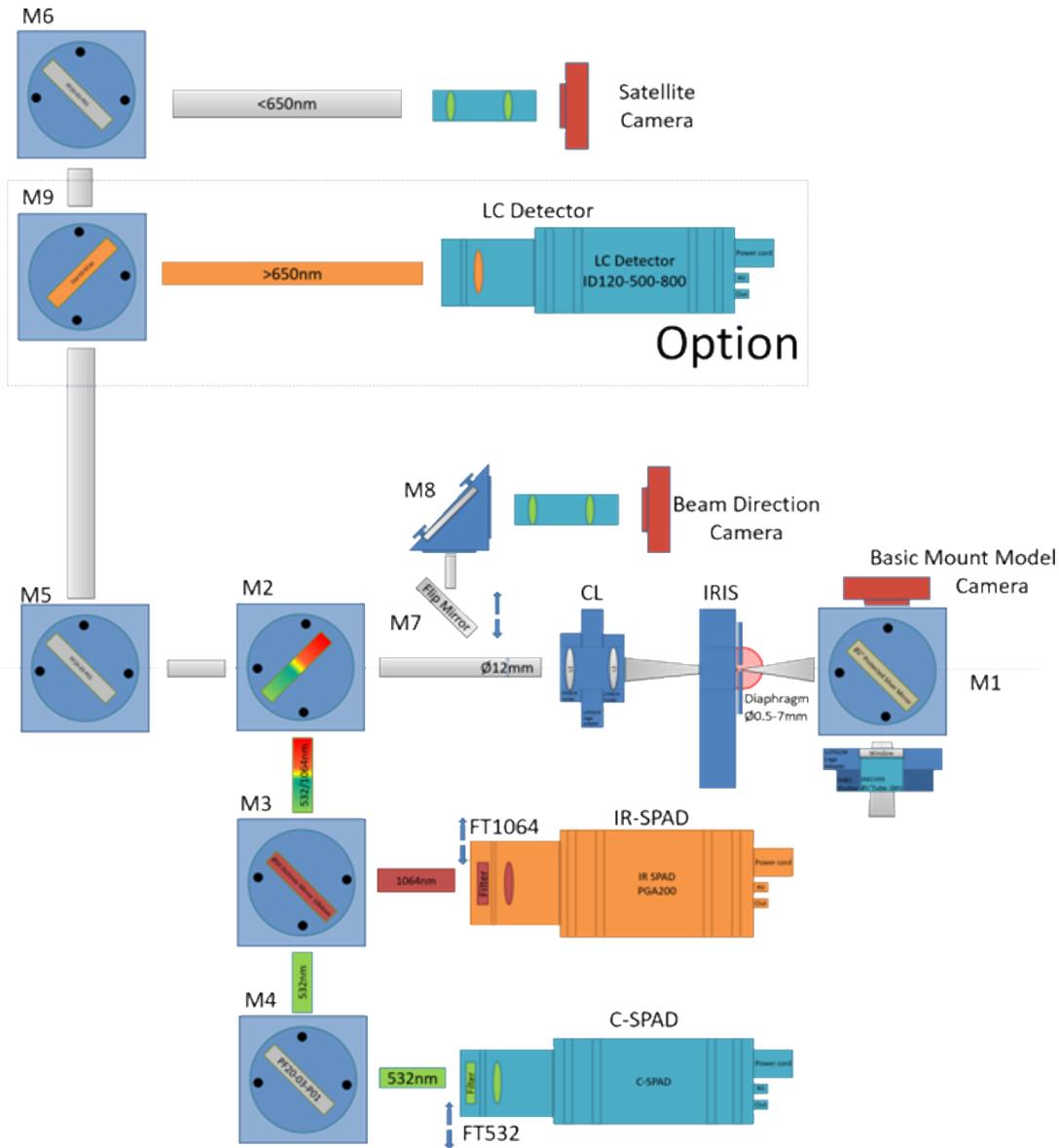
- Space Debris Observation Camera
- Installation of a filter wheel (daylight filters)
- Sensor size 36mm x 24mm
- 3.76um pixel size

Range Gate Generator + SD optimized



Aircraft Detection Unit + Visual Detection



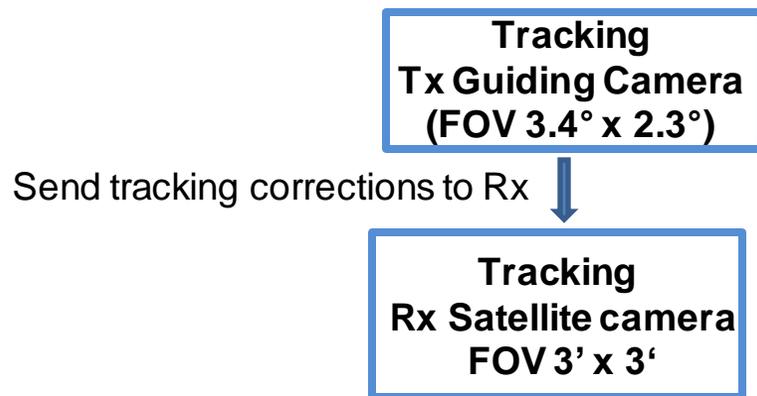


Detector Package

- Installation of an additional SPAD for light curve measurements
- No further upgrades

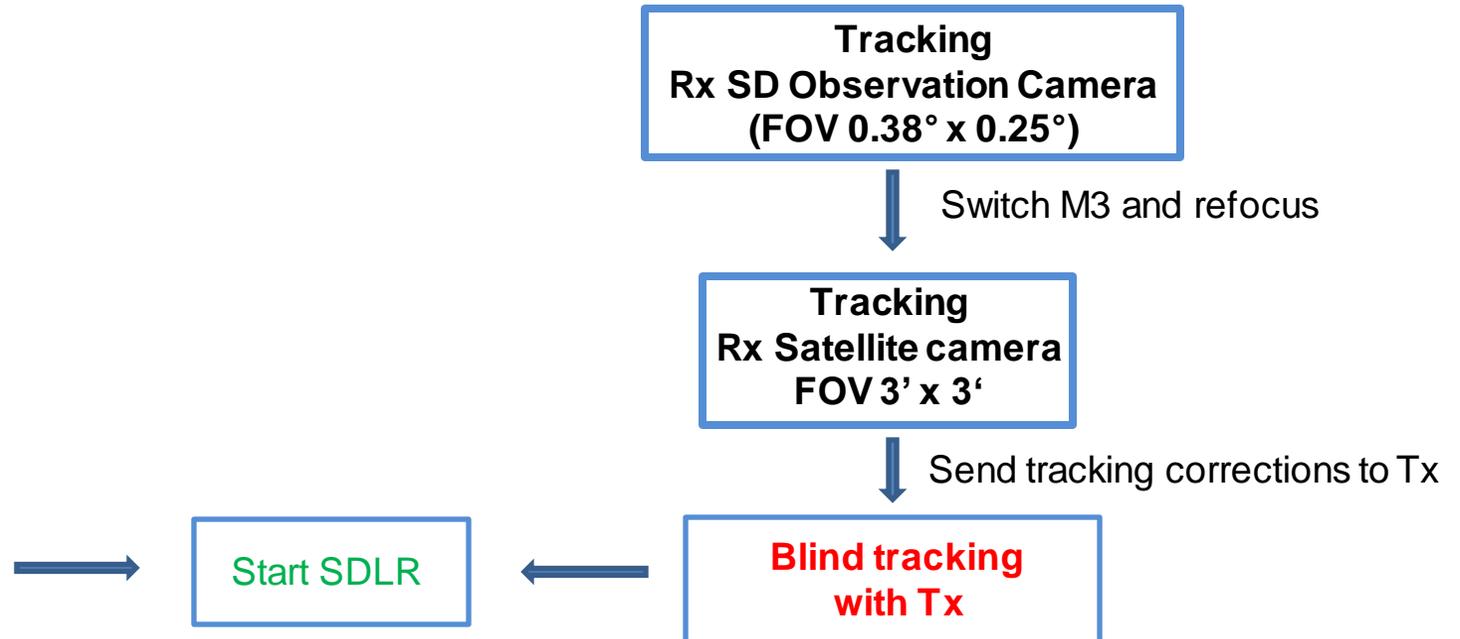
Guiding system 1

Less sensible, simultaneously use with laser ranging

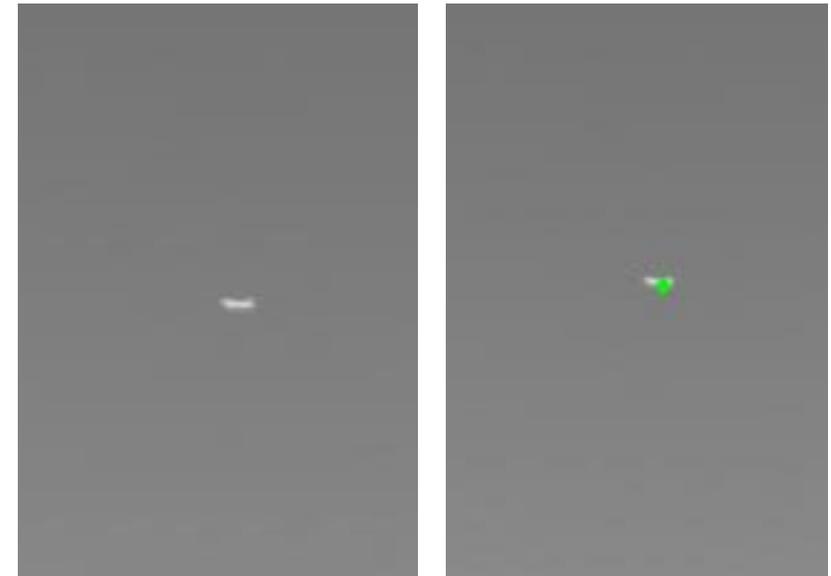


Guiding system 2

More sensible, essential for day time observations but no simultaneously use with laser ranging

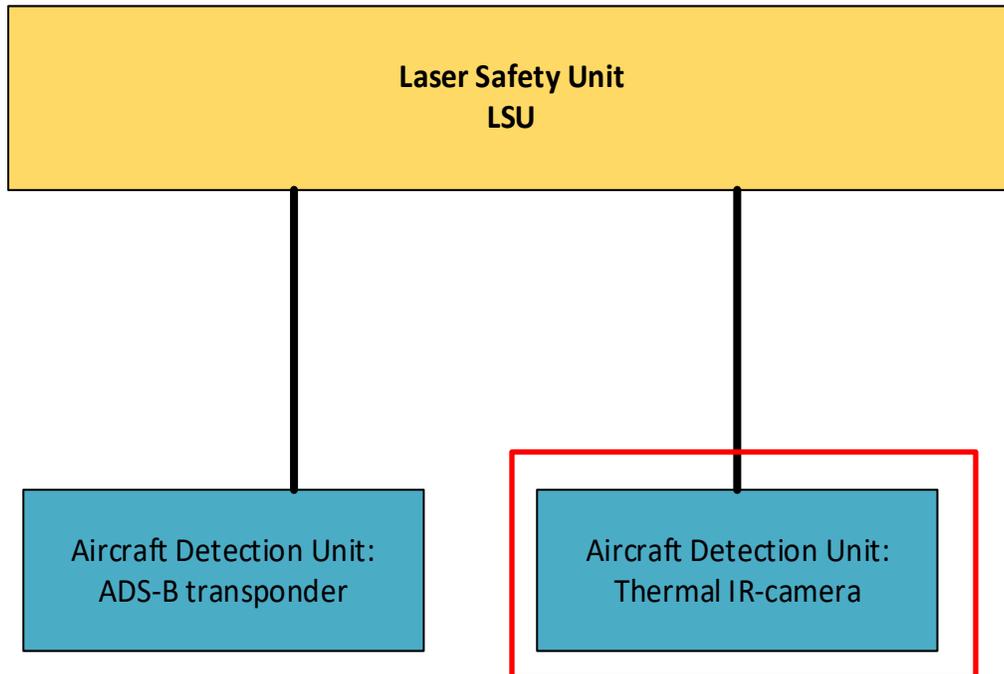


- Laser class 4 → DIN-EN-60825-12 applies
 - Operation only allowed within controlled area
 - Multi-folded, combined HW and SW security
 - Access control implemented
 - Automatic shutter activation in case of low elevation



T-IR cam during day: raw vs. processed

Talk in Session 8 today at 15:15: Hrithik Pandey





Thanks for your attention!
See more impressions on DiGOS website: <https://digos.eu>